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**APPEAL BRIEF**

Applicant	:	Francis X. Canning
App. No	:	09/676,727
Filed	:	September 29, 2000
For	:	COMPRESSION AND COMPRESSED INVERSION OF INTERACTION DATA
Examiner	:	Herng Der Day
Art Unit	:	2128

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

In accordance with the Notice of Appeal filed July 1, 2009, Applicant submits this Appeal Brief.

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### **I. REAL PARTY IN INTEREST**

Francis X. Canning is the real party in interest. This application has not been assigned.

### **II. RELATED APPEALS AND INTERFERENCES**

There are no known related appeals or interferences.

### **III. STATUS OF CLAIMS**

Claims 1-22, 34, and 40-55 are pending. Claims 1-22, 34, and 40-55 stand rejected under 35 U.S.C. § 101. Claims 1-22, 34, and 40-54 stand rejected under 35 U.S.C. § 112. The rejections of Claims 1-22, 34, and 40-55 under 35 U.S.C. § 101 and Claims 1-22, 34, and 40-54 under 35 U.S.C. § 112 are currently appealed.

### **IV. STATUS OF AMENDMENTS**

Applicant submitted an Amendment dated November 25, 2008. The Office Action of February 2, 2009 entered this amendment to the claims.

### **V. SUMMARY OF CLAIMED SUBJECT MATTER**

#### **OVERVIEW OF THE CLAIMED SUBJECT MATTER**

The present application involves a compression technique that is used to compress certain types of data, termed "interaction data", into a manageable size. This technique has the useful, concrete and tangible effect of transforming large amounts of information into smaller amounts of information, while still providing enough information to accurately analyze the information. By pairing down the information, less memory and less computing power is needed to analyze the information. See Applicant's Specification at Page 18 lines 11-18 and Page 27 lines 10-25.

One example of interaction data is an array of numbers where each number describes the electrostatic force that a charged particle (a source) exerts on another charged particle (a tester). Alternatively, some composite sources might be used consisting of two nearby charges of opposite strength. The electric field from a single charge decays as one over the distance from that charge. The electric field from two charges of opposite strength decays much faster, approximately as the square of one over the distance from it. Thus, an array of interaction data using composite sources (with a plus and a minus component) will likely have more very small

numbers in it. An idealized or fictional source consisting of a plus and a minus charge arbitrarily close together is often used for efficiency by physicists in such calculations. This idealized or fictional source is called a dipole. *See* Applicant's Specification at Page 11 lines 5-6 and Page 5 lines 24-28. Methods are disclosed in the present application for producing fictional or composite sources that produce a physical effect and that can be used to compress interaction data. As the specification states on Page 14 lines 26-28: "Thus, a composite source (or combination of composite sources) efficiently produces the same approximate effects as the group of original sources ...."

The interaction data can include a matrix of interaction data used in solving an integral equation. For example, such a matrix of interaction data occurs in the moment method for solving problems in electromagnetics. *See* Applicant's Specification at Page 6 line 20 through page 10 line 6 and Figure 1. The interaction data often describes the interaction between a source and a tester. *See* Applicant's Specification at Page 6 lines 12-19. The present application also involves replacing sources by composite sources and/or replacing testers by composite testers. *See* Applicant's Specification at Page 10 line 13 through Page 18 line 10, Page 23 line 5 through Page 26 line 15 and Figures 3-7. Some of the composite sources produce a very weak or negligible effect when tested by some of the original or some of the composite testers. *See* Applicant's Specification at Page 22 line 22 through Page 26 line 15 and Figures 8-9 and 11-12. Some of the composite testers are relatively insensitive to an incoming effect from some of the original sources or some of the composite sources. The weak interactions allow the interaction matrix to be stored using less storage. *See* Applicant's Specification at Page 17 line 12-18.

One embodiment disclosed in the specification modifies the use of an existing computer program to perform computations more efficiently. The Specification states "One embodiment of the composite source compression technique is used in connection with the computer program NEC2.... NEC2 uses electric currents flowing on a grid of wires to model electromagnetic scattering and antenna problems." *See* Applicant's Specification at Page 21, lines 17-18 and 23-24.

Figure 10 is a flow chart describing how the existing program NEC2 is modified to use composite sources and/or testers. In step 1005, composite sources and testers are computed. In step 1006, an array of interaction data is found using these composite sources and testers. This

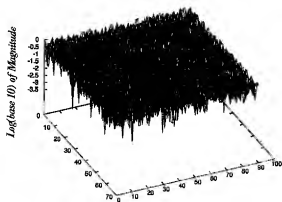
interaction data describes, for example, electrical effects on a body that is modeled as a wire grid. The electrical source exciting the body is computed in step 1018. As an example, this can be an incident radar wave that excites a body and that in turn will produce a scattered radar wave. In this embodiment, step 1021 finds the composite sources flowing on the body and step 1023 uses them to find the original sources flowing on the body. The use of composite sources in this computation allows greater efficiency in the calculation. Compression of the interaction data allows fewer numbers to be used saving storage and allowing computations with fewer operations.

Once NEC2 finds the original sources excited on a body, it has the options of computing various physical effects of these sources. For radar scattering problems, the scattered electromagnetic wave is computed from these sources. *See Applicant's Specification at Page 23 lines 16-20.* In the case of NEC2, the original sources comprise an electric current. The specification states on Page 6, lines 3-8, "A magnetic current is another example of a fictitious source that is often used. It is generally assumed that magnetic monopoles and magnetic currents do not exist (while electric monopoles and electric currents do exist). Nevertheless, it is known how to mathematically relate electric currents to equivalent magnetic currents to produce the same electromagnetic waves. The use of magnetic sources is widely accepted and has proven very useful for certain types of calculations." This states that although magnetic currents are a fictitious source, they model a real physical effect, and are therefore useful in transforming raw data into useful information.

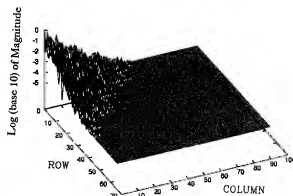
Thus, in some embodiments a computation can describe the scattered electric field, produced by an incident electric field, where the intermediate step is computing either an electric current or a magnetic current. While the magnetic current is not a real physical quantity, nevertheless as the specification states, it produces "the same electromagnetic waves" as using electric currents in the intermediate step.

Figures 11-12 of the Specification give an example of the compression that is possible when these methods are used to improve the efficiency of the existing program NEC2. These figures show a part of a larger array of interaction data. Figure 11 shows that using the original sources and testers, all of the elements have roughly the same size (magnitude). Figure 12 shows that after changing to use composite sources and testers, the great majority of elements of

this part are roughly one hundred thousand times smaller, and are negligible for many purposes. As a result, the present invention and use of composite sources is useful in transforming large amounts of information into a smaller, more useful amount of information.



**FIG. 11**



**FIG. 12**

**SPECIFIC TERMS USED IN THE CLAIMS**

With regard to Claim 1, basis functions are shown in Figure 1 and a region is discussed on Page 12 line 25 through Page 13 line 7 and in Figure 3. A system of linear equations is discussed on Page 8 line 18 through Page 9 line 17. An unknown in a system of linear equations is discussed on Page 9 lines 3-13. Spherical angles are discussed on Page 13 lines 13-20. A far field disturbance and a matrix of transmitted disturbances are discussed on Page 14 lines 1-18. Composite sources are discussed on Page 14 line 19 through Page 15 line 9. Rank reduction is discussed on Page 15 lines 6-23. Weighting functions are discussed on Page 8 lines 14-23. A matrix of received disturbances is discussed on Page 16 lines 7-15. Composite testers are discussed on Page 16 lines 7-19. Transforming a system of equations to use composite sources and testers is discussed on Page 26 lines 16-27 and Figure 7.

Claim 2 contains some terms that are not used in Claim 1. A physical source is discussed on Page 5 line 24 through Page 6 line 13. Angular directions are discussed on Page 22 line 24 through Page 23 line 4. A relatively weak disturbance is discussed on Page 24 lines 4-8 and Page 25 lines 24-28 and Figures 8, 9, and 12. A compressed portion is shown in and Figures 8, 9, and 12.

## **VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL**

Claims 1-22, 34, and 40-55 are pending. At issue on appeal are the rejections of Claims 1-22, 34, and 40-54 under 35 U.S.C. 112 second paragraph and of Claims 1-22, 34, and 40-55 under 35 U.S.C. § 101.

### **REJECTION OF CLAIMS 1-22, 34, AND 40-54 UNDER 35 U.S.C. 112 SECOND PARAGRAPH**

The grounds to be reviewed are, when a claim recites a step using an open description such as “comprising”, and this step is used in producing a claimed result, is that claim therefore indefinite and to be rejected under 35 USC 112 second paragraph.

In other words, is it proper to notice that one can always construct an additional element to be added to that step and then to state that the claim is indefinite under 35 USC 112 second paragraph since either

- (i) it is unclear what that step really comprises
- or
- (ii) it is unclear how this additional element is useful in producing the claimed result.

The Office Action of February 2, 2009 (“the Office Action”) rejected Claim 1 and its dependant Claims 34, and 40-41 because “It is vague and indefinite because it is unclear what the *basis functions* other than said “a plurality of said basis functions in said first group describes electric fields produced by electric charge” as recited in lines 9-10 of the claim, are really referred to in order to compute...” Page 3 lines 17-20.

The Office Action rejected Claim 2 and its dependant Claims 3-9, and 42-49. The Office Action stated, “It is vague and indefinite because it is unclear what “said physical sources” are really referred to in order to compute at least one of the above recited results.” Page 4 lines 11-13.

The Office Action rejected Claim 10 and its dependant Claims 11-22 and 50-54 because “It is vague and indefinite because it is unclear what “said more than one basis functions” are really referred to in order to compute at least one of the above recited results. In other words, if “said more than one basis functions” describe “sources” or “physical sources” such as, economic data or stock prices, it is unclear how to compute the recited at least one of the above results using said second equations.” Page 5 lines 5-9.

**REJECTION OF CLAIMS 1-22, 34, AND 40-55 UNDER 35 U.S.C. 101**

With regard to the rejections of Claims 1-22, 34 and 40-55 under 35 U.S.C. 101, The Office Action states, "On the other hand, the claimed subject matter is seeking to patent substantially every application of the idea of compression data using composite sources and/or composite testers." Page 7 lines 8-10. The Office Action also states, "More specifically, the claimed subject matter includes transforming a system of linear equations to use composite sources and/or composite testers to ...and computing a resulting electric field, at least one of an electromagnetic field, a heat flux, an electric field, a magnetic field, .... This produced result from abstract sources remains in the abstract and, thus, fails to achieve the required status of having real world value." Page 7 lines 14-20.

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## **VII. ARGUMENT**

### **GROUPING OF CLAIMS RE THE 35 U.S.C. 112 SECOND PARAGRAPH REJECTION**

The Office Action has grouped the claims into three groups for the 35 U.S.C. 112 rejection. These groups are Claim 1 and claims dependent on it, Claim 2 and claims dependent on it, and Claim 10 and claims dependent on it. Applicant combines the second and third groups for his argument. Therefore, regarding this rejection Applicant uses the two claim groups:

Group A: Claim 1 and Claims 34, 40-41 depending on Claim 1

Group B: Claim 2 and Claims 3-9, and 42-49 depending on Claim 2 and Claim 10 and Claims 11-22, and 50-54 depending on Claim 10.

### **GROUPING OF CLAIMS RE THE 35 U.S.C. 101 REJECTION**

The Office Action has grouped all of the pending claims, Claims 1-22, 34, and 40-55, into one group for the 35 U.S.C. 101 rejection. Regarding this rejection, Applicant groups the claims as:

Group I: Claims 2-11, 17-22, and 42-54.

Group II: Claims 1, 12-16, 34, and 40-41.

Group III: Claim 55.

### **ARGUMENTS APPLYING TO ALL CLAIMS AND ALL GROUNDS OF REJECTION**

The Office Action's interpretation of the claim language used for rejection under 35 U.S.C. 112 appears to be inconsistent with his interpretation of claim language used for the rejection under 35 U.S.C. 101. The issue appears to be whether terms such as an electric field, a sound wave, etc. describe something physical or whether they have been broadened to include non-physical results. Regarding the 112 rejection, the Office Action appears to state that the claimed results such as an electric field are necessarily a real physical quantity, and therefore, the claim language is vague and indefinite since the sources used to compute them may include "non-physical" sources. However, regarding the 101 rejection, the Office Action's position appears to be that terms such as an electric field have been broadened to include something non-physical. Applicant respectfully asserts that these positions are inconsistent.



The meaning of these claim terms, such as electric field, are terms of art that have clear meanings to those of skill. Moreover, the Applicant has not changed those meanings. As a result, Applicant respectfully asserts that the Office Action is inconsistent regarding the interpretation of terms such as electric field and that the interpretation used in forming its rejections under 35 U.S.C 101 is unreasonable.

It appears that the rejections are based on a misunderstanding of the Applicant's disclosure. In particular, in its disclosure, Applicant refers to "fictitious" sources. The use of "fictitious" or "imaginary" sources are techniques for modeling real world phenomena and are well understood by those of skill in the art. For example, the following paragraphs from the specification describe how these sources are used to accurately model a real world phenomena:

"Sometimes it is convenient to consider disturbances as being created by an equivalent source (e.g., a fictitious source) rather than a real physical source. For example, in most regions of space (a volume of matter for example) there are a large number of positive electric charges and a large number of negative electric charges. These positive and negative charges nearly exactly cancel each other out. It is customary to perform calculations using a fictitious charge, which is the net difference between the positive and negative charge, averaged over the region of space. This fictitious charge usually cannot be identified with any specific positive or negative particle.

"A magnetic current is another example of a fictitious source that is often used. It is generally assumed that magnetic monopoles and magnetic currents do not exist (while electric monopoles and electric currents do exist). Nevertheless, it is known how to mathematically relate electric currents to equivalent magnetic currents to produce the same electromagnetic waves. The use of magnetic sources is widely accepted, and has proven very useful for certain types of calculations. Sometimes, it is convenient to use a source that is a particular combination of electric and magnetic sources. A distribution of sources over some region of space can also be used as a source. The terms "sources" and "physical sources" are used herein to include all types of actual and/or fictitious sources."

Page 5, line 24-Page 6, line 11.

The plain meaning of these paragraphs is to teach how to design and use fictitious sources that model real physical effects and to state that this is already known to persons having an

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ordinary skill in the art. For example, note the statement quoted above, "Nevertheless, it is known how to mathematically relate electric currents to equivalent mathematical currents to produce the same electromagnetic waves." Thus, although magnetic currents do not exist in the sense that they cannot be observed, nevertheless they are specifically designed to produce a real physical effect and may be used to compute a real physical effect.

**ARGUMENTS APPLYING TO ALL REJECTIONS UNDER 35 U.S.C. 112 SECOND PARAGRAPH**

These arguments apply to all 35 U.S.C. 112 rejections, i.e., to the claims in Groups A and B. Applicant's response of November 25, 2008 to the Office Action of May 29, 2008 did not amend the wording in question. The Office Action of February 2, 2009 entered this new rejection that had not been given in the previous ten Office Actions.

In the Office Action of February 2, 2009, on Page 9 the fourth line from the bottom through Page 10 line 1, the Office Action states, "First, as detailed in paragraphs 4-1 to 4-3 above, the recited "basis functions", "said physical sources" and "said more than one basis functions" are vague and indefinite because in view of the specification with the broadest reasonable interpretation, they may describe heterogeneous sources and include all types of actual and/or fictitious sources. Therefore, how to compute the argued results is unclear."

Whenever one uses the word "comprising" regarding the basis functions (or anything else), that allows the possibility that what is described is heterogeneous. The word comprising does not render the *scope* of a claim indefinite. Indeed, under Examiner's reasoning the word comprising would render any claim indefinite, since it is always unclear what additional elements might be allowed.

Under a second line of Examiner's arguments, the claim language is indefinite because if certain heterogeneous sources are used, "how to compute the argued results is unclear." Persons having an ordinary skill in the art would not, for example, attempt to produce an electric field from a stock price. The Examiner's argument seeks to require that the claim language incorporates this limitation. Patent law has never required such a limitation to be stated within a claim, but rather has asked if a person skilled in the art would know how to practice the claim.

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In addition, this argument of the Examiner does not address the topic of whether the scope of the claim is indefinite.

**ARGUMENTS APPLYING TO REJECTION OF CLAIM GROUP A UNDER 35 U.S.C. 112 SECOND**

**PARAGRAPH**

The Office Action states regarding Claim 1 and Claims 34, 40-41 depending on Claim 1, "It is vague and indefinite because it is unclear what the *basis functions* other than said "a plurality of said basis functions in said first group describes electric fields produced by electric charge" as recited in lines 9-10 of the claim, are really referred to in order to compute ... and to compute the resulting electric field. Therefore, if the basis functions are heterogeneous (i.e., other than describing electric fields but also describing, for example, water, stock price, and/or pixels) it is unclear whether the composite sources are still meaningful for computing the recited electric field." Page 3 lines 17 through Page 4 line 4.

The claim recites, "a plurality of said basis functions in said first group describes electric fields produced by electric charge," and further recites computing "a resulting electric field." The Examiner uses his clear understanding of the claim to note that the basis functions might be heterogeneous and that within the scope of the claim language some of the basis functions might additionally describe stock prices.

A person skilled in the art would not attempt to compute an electric field from a stock price, but rather could use electric currents or magnetic currents to compute an electric field as disclosed by the specification. There is no requirement that the scope of the claim itself enforces this. Such a requirement would effectively state that the claim language by itself, without a person skilled in the art, is sufficient to practice the invention. The Examiner seeks to impose such a requirement by arguing that it is unclear how composite sources using a stock price "are still meaningful for computing the recited electric field."

Furthermore, the Examiner's argument does not address the topic of whether the scope of the claim is indefinite.

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**ARGUMENTS APPLYING TO REJECTION OF CLAIM GROUP B UNDER 35 U.S.C. 112 SECOND**

**PARAGRAPH**

Applicant will use the representative Claim 2 to argue the rejection of Claim 2 and Claims 3-9, and 42-49 depending on Claim 2 and Claim 10 and Claims 11-22, and 50-54 depending on Claim 10.

The Office Action states regarding Claim 2: "Therefore, when 'said physical sources' are, for example, economic data or stock prices, it is unclear how to compute the recited at least one of the above results. Furthermore, if the 'original physical sources' are heterogeneous (e.g., water, stock price, and pixels) it is unclear whether the computed composite source (i.e., a linear combination of one or more of the original sources as described in lines 3-4 of Page 15) is still meaningful for computing the recited at least one of the above results." Page 4 lines 15-20.

The Examiner has argued that the term "physical sources" is defined broadly in the specification, and therefore Claim 2 allows it to have a broad interpretation. The Examiner further argues that the claim language allows the physical source to include say a stock price, and then states "it is unclear" if this "is still" meaningful for computing one of the recited physical effects. The Examiner's arguments are presented using his clear understanding of the scope of the claim. These arguments miss the topic of whether the scope of the claim is indefinite.

One skilled in the art might produce the recited "sound wave" in Claim 2 using water as a source or might produce the recited "electric field" in Claim 2 using an electric current as a source. A person skilled in the art would not attempt to use water as a source for producing an electric field even though this limitation is not explicitly given within the claim. The Examiner's argument, if correct, would require such a limitation. Patent law has never required such a limitation to be stated within a claim, but rather has asked if a person skilled in the art would know how to practice the claim.

Furthermore, the Examiner's argument does not address the topic of whether the scope of the claim is indefinite.

**ARGUMENT APPLYING TO ALL REJECTIONS OF CLAIMS UNDER 35 U.S.C. 101**

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Regarding the rejections of claims in groups I, II, and III, i.e., Claims 1-22, 34, and 40-55, the Federal Circuit recently reviewed when process-type claims represent patent eligibly subject matter. *See In re Bilski*, 545 F.3d 943, 88 U.S.P.Q.2d (BNA) 1385 (Fed. Cir. Oct. 30, 2008). In its ruling, the Federal Circuit stated that the tangible, concrete and useful result test of the *State Street Bank* decision is not the full and proper test for patentability under § 101. The Court ruled that the determination of patentability should be based on the machine-or-transformation test put forth by the Supreme Court. In analyzing the machine-or-transformation test, the Federal Circuit provided two alternative tests for analyzing patent eligibility: (1) the patent claims are tied to a particular machine or apparatus; *or* (2) the patent claims transform a physical object or substance, or an electronic signal representative of any physical object or substance.

The court in *Bilski* gave an example of an eligible transformation of electronic data representing physical objects, stating:

“We further note for clarity that the electronic transformation of the data itself into a visual depiction in Abele was sufficient; the claim was not required to involve any transformation of the underlying physical object that the data represented.”

*Bilski* at 963.

All of the present claims satisfy the transformation test. As described below with regard to each limitation, all of the claims describe transforming representations of physical data into useful information about physical effects. Specifically, the claims recite methods of data compression in conjunction with computing a physical phenomena, for example, an electric field.

In addition, all of the present claims also satisfy the machine test since they are tied to a particular machine or apparatus, e.g. a computer processor. In addition, all of the present claims specifically transform a machine into a more efficient apparatus by compressing data within that machine and using the compressed data. Under the machine-or-transformation test, all of the claims of the present application involve patentable subject matter under §101.

#### **ARGUMENTS APPLYING TO THE CLAIMS IN GROUP I**

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All of the claims in this group recite “to compute at least one of an electromagnetic field, a heat flux, ...” and thus produce a useful concrete and tangible result. For Claim 2 and those in this group depending on Claim 2, this result is recited as “due, at least in part, to said physical source.” For Claim 10 and those in this group depending on Claim 10, this is “resulting, at least in part, from said more than one basis functions.”

Regardless of whether “said physical source” or “said more than one basis functions” represents something itself physical or not, the claim is limited to producing a real physical result. That is, the result computed is a real physical effect, regardless of the method used to produce it. The claimed physical results such as an electric field or a heat flux, etc. have a well known meaning to persons having an ordinary skill in the art. The Office Action would like to broaden that meaning for the 35 U.S.C 101 rejection but not for the 35 U.S.C 112 rejection. The only justification given is the Office Action’s skepticism about the existence of non-physical sources that produce a real physical effect, even though they are (i) taught in the Specification, and (ii) well known to persons having an ordinary skill in the art. The arguments presented above regarding Claim groups I, II, and III combined show this is a useful concrete and tangible result produced on a specific computer and these claims do not preempt substantially all applications of the use of composite sources and/or testers.

#### **ARGUMENTS APPLYING TO THE CLAIMS IN GROUP II**

All of the claims in this group recite either “computing a resulting electric field” or “to compute at least one of an electromagnetic field, a heat flux, ...” and thus produce a useful concrete and tangible result. For all of the claims in this group a real physical quantity is recited as being used in computing this result. For example, Claim 1 recites, “a plurality of said basis functions in said first group describes electric fields produced by electric charge.” Regardless of what else the basis functions comprise, the computation of a real physical effect is recited. The arguments presented above show this is a useful concrete and tangible result produced on a specific computer and that these claims do not preempt substantially all applications of the use of composite sources and/or testers.

#### **ARGUMENTS APPLYING TO THE CLAIM IN GROUP III**

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This claim recites computing a disturbance “produced by said physical sources comprising at least one of an electromagnetic field, a heat flux, ...” Regardless of what other methods are used in computing this result, it remains that a real physical effect that is computed. Thus, regardless of whether the term “physical source” when used by itself includes equivalent sources that are non-physical, the recited disturbance is produced by one of the specific real physical effects listed, and thus is a real physical effect. Thus, this claim produces a useful concrete and tangible result. The arguments presented above regarding Claim groups I, II, and III combined show this result is computed on a specific computer and these claims do not preempt substantially all applications of the use of composite sources and/or testers.

#### **CONCLUSION**

All of the claims of the present Application have a clear and non ambiguous scope. All of these claims are directed to transforming real physical objects or electronic signals representative of physical objects into a different representation of those physical objects using a special purpose computer. All of the claims involve the use of a specific computer. As such, all of the claims of the present Application involve patentable subject matter under the Federal Circuits new interpretation of 35 U.S.C. § 101 put forth in Bilski.

### **VIII. CLAIMS APPENDIX**

1. A method of data compression, comprising:

using software loaded into a computer memory attached to a computer processor, partitioning a first set of basis functions into groups, each group corresponding to a region, each basis function corresponding to one unknown in a system of linear equations, each of said basis functions corresponding to an original source;

selecting a plurality of spherical angles;

calculating a far-field disturbance produced by each of said basis functions in a first group for each of said spherical angles to produce a matrix of transmitted disturbances wherein a plurality of said basis functions in said first group describes electric fields produced by electric charge;

on said computer processor, using a first rank reduction to reduce a rank of said matrix of transmitted disturbances to yield a second set of basis functions, said second set of basis functions corresponding to composite sources, each of said composite sources comprising a linear combination of a plurality of said original basis functions;

partitioning a first set of weighting functions into groups, each group corresponding to a region, each weighting function corresponding to a condition, each of said weighting functions corresponding to an original tester;

calculating a far-field disturbance received by each of said testers in a first group for each of said spherical angles to produce a matrix of received disturbances;

on said computer processor, using a second rank reduction to reduce a rank of said matrix of received disturbances to yield a second set of weighting functions, said second set of weighting functions corresponding to composite testers, each of said composite testers comprising a linear combination of a plurality of said original testers; and

transforming said system of linear equations to use said composite sources and said composite testers to produce a second system of equations wherein at least a portion of said second system of equations is compressed relative to said system of linear equations and wherein for at least a first portion of said second system of equations, said



first portion using said composite sources and said composite testers, at least a portion of said matrix of transmitted disturbances is different from said matrix of received disturbances and using said second system of equations wherein said compression enables relatively more efficient use of said second system of equations; and

using said second system of equations computing a resulting electric field due, at least in part, to said plurality of said basis functions in said first group.

2. A method of data compression, comprising:

using a computer program in a computer-readable medium, partitioning a first set of basis functions into groups, each group corresponding to a region, each basis function corresponding to an unknown in a system of equations, each of said basis functions corresponding to an original physical source;

selecting a first plurality of angular directions;

using a computer system, calculating a disturbance produced by each of said basis functions in a first group for each of said angular directions to produce a matrix of disturbances;

using said matrix of disturbances to compute a second set of basis functions, said second set of basis functions corresponding to composite sources, wherein at least one of said composite sources is configured to produce a relatively weak disturbance from a portion of space around said at least one composite source;

partitioning a first set of weighting functions into groups, each group corresponding one of said regions, each weighting function corresponding to a condition, each of said weighting functions corresponding to an original tester;

using a computer system, calculating a disturbance received by each of said testers in a second plurality of angular directions to produce a matrix of received disturbances;

using said matrix of received disturbances to compute a second set of weighting functions, said second set of weighting functions corresponding to composite testers,

wherein at least one of said composite testers is configured to weakly receive disturbances from a portion of space relative to said at least one composite tester;

transforming at least a first portion of said system of equations into a transformed system of equations to use one or more of said composite sources and one or more of said composite testers wherein at least a second portion of said transformed system of equations is compressed relative to said system of equations;

wherein for an element of said second portion said matrix of disturbances is, at least in part, different from said matrix of received disturbances; and

using said compressed second portion of said transformed system of equations to compute at least one of an electromagnetic field, a heat flux, an electric field, a magnetic field, a vector potential, a pressure, a sound wave, a particle flux, a weak nuclear force, a strong nuclear force, and a gravity force due, at least in part, to said physical sources.

3. The method of Claim 2, wherein said matrix of disturbances is a moment method matrix.

4. The method of Claim 2, wherein said step of using said matrix of disturbances to compute a second set of basis functions comprises reducing a rank of said matrix of disturbances.

5. The method of Claim 2, wherein said step of using said matrix of received disturbances to compute a second set of weighting functions comprises reducing a rank of said matrix of received disturbances.

6. The method of Claim 2, wherein said disturbance is at least one of an electromagnetic field, a heat flux, an electric field, a magnetic field, a vector potential, a pressure, a sound wave, a particle flux, a weak nuclear force, a strong nuclear force, and a gravity force.

7. The method of Claim 2, wherein said first plurality of angular directions is substantially the same as said second plurality of angular directions.

8. The method of Claim 2, wherein said regions of space around said at least one composite source are far-field regions.

9. The method of Claim 2, wherein said at least a portion of a region around said at least one composite tester is a far-field region.

10. A method of data compression, comprising:

using software loaded into a computer-readable memory attached to a computer processor, calculating one or more composite sources as a linear combination of more than one basis functions, wherein at least one of said composite sources is configured to produce a relatively weak disturbance in a portion of space related to said at least one composite source;

using said computer processor, calculating one or more composite testers as a linear combination of more than one weighting functions, wherein at least one of said composite testers is configured to be relatively weakly affected by disturbances propagating from a portion of space around said at least one composite tester;

using said computer processor, transforming at least a portion of a first system of equations based on said basis functions and said weighting functions into second equations based on said composite sources and said composite testers, wherein for an element of said second equations one of said one or more composite sources and one of said one or more composite testers are computed using at least partially different data, and wherein said second equations are compressed relative to said first system of equations; and

using said second equations to compute at least one of an electromagnetic field, a heat flux, an electric field, a magnetic field, a vector potential, a pressure, a sound wave, a

particle flux, a weak nuclear force, a strong nuclear force, and a gravity force resulting, at least in part, from said more than one basis functions.

11. The method of Claim 10, wherein said disturbance is at least one of, an electromagnetic field, a heat flux, an electric field, a magnetic field, vector potential, a pressure, a sound wave, a particle flux, a weak nuclear force, strong nuclear force, and a gravity force.

12. The method of Claim 10, wherein said composite sources comprise electric currents.

13. The method of Claim 10, wherein said composite sources comprise magnetic currents.

14. The method of Claim 10, wherein said composite sources comprise acoustic sources.

15. The method of Claim 10, wherein said composite sources comprise electromagnetic sources.

16. The method of Claim 10, wherein said composite sources comprise thermal sources.

17. The method of Claim 10, wherein each of said composite sources corresponds to a region.

18. The method of Claim 10, wherein said second system of equations is described by a sparse block diagonal matrix.

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19. The method of Claim 18, further comprising the step of reordering said sparse block diagonal matrix to shift relatively larger entries in said matrix towards a desired corner of said matrix.

20. The method of Claim 10, further comprising the step of solving said second system of equations.

21. The method of Claim 10, further comprising the step of solving said second system of equations to produce a first solution vector, said first solution vector expressed in terms of said composite testers.

22. The method of Claim 21, further comprising the step of transforming said first solution vector into a second solution vector, said second solution vector expressed in terms of said weighting functions.

23.-33. (Canceled)

34. The method of Claim 1, wherein said transforming said system of linear equations produces a substantially sparse system of linear equations.

35.-39. (Canceled)

40. The method of Claim 1, wherein said matrix of received disturbances comprises a moment-method matrix.

41. The method of Claim 1, wherein said matrix of transmitted disturbances comprises a moment-method matrix.

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42. The method of Claim 2, wherein said matrix of received disturbances comprises a moment-method matrix.

43. The method of Claim 2, wherein said transforming at least a portion of said system of equations to use one or more of said composite sources and one or more of said composite testers comprises transforming substantially all of said system of equations to use one or more of said composite sources and one or more of said composite testers.

44. The method of Claim 43, wherein said transforming substantially all of said system of equations produces substantial sparseness.

45. The method of Claim 2, wherein said relatively weak disturbance from a portion of space around said at least one composite source comprises a relatively weak disturbance from a far-field portion of space.

46. The method of Claim 2, wherein said relatively weak disturbance from a portion of space around said at least one composite source comprises a portion of space at distances relatively shorter than a distance to other physical regions.

47. The method of Claim 46, wherein said portion of space at distances relatively shorter than a distance to other physical regions comprises a relatively non-intertwining portion of space.

48. The method of Claim 2, wherein said relatively weak disturbance from a portion of space around said at least one composite source comprises a portion of space comprising substantially all angular directions in said first plurality of angular directions.

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49. The method of Claim 48, wherein said portion of space comprising substantially all angular directions in said first plurality of angular directions comprises a relatively non-intertwining portion of space.

50. The method of Claim 10, wherein said transforming at least a portion of a first system of equations comprises transforming substantially all of a first system of equations based on said basis functions and said weighting functions into a second system of equations based on said composite sources and said composite testers.

51. The method of Claim 50, wherein said second system of equations is substantially sparse.

52. The method of Claim 10 wherein said at least a portion of a first system of equations comprises an interaction between at least one of said basis functions is relatively close to and at least one of said weighting functions.

53. The method of Claim 52 wherein either said one or more composite sources is calculated using a matrix of transmitted disturbances or said one or more composite testers is calculated using a matrix of received disturbances.

54. The method of Claim 10 wherein either said one or more composite sources is calculated using a matrix of transmitted disturbances or said one or more composite testers is calculated using a matrix of received disturbances.

55. A method of data compression, comprising:

using a computer program in a computer-readable memory attached to a computer processor, partitioning a first set of basis functions into groups, each group corresponding

to a region, each basis function corresponding to one unknown in a system of linear equations, each of said basis functions corresponding to a physical source;

selecting a plurality of spherical angles;

calculating a far-field disturbance produced by each of said basis functions in a first group for each of said spherical angles to produce a matrix of transmitted disturbances;

on said computer processor reducing a rank of said matrix of transmitted disturbances to yield a second set of basis functions, said second set of basis functions corresponding to composite sources, each of said composite sources comprising a linear combination of a plurality of said original basis functions;

identifying weighting functions, each weighting function corresponding to a condition, each of said weighting functions corresponding to a tester; and

on said computer processor transforming said system of linear equations to use one or more of said composite sources and one or more of said testers to produce a second system of equations wherein at least a portion of said second system of equations is compressed relative to said system of linear equations and wherein at least a first portion of said second system of equations uses said composite sources and said original testers; and

using said transformed system of equations to compute a disturbance produced by said physical sources, said disturbance produced by said physical sources comprising at least one of an electromagnetic field, a heat flux, an electric field, a magnetic field, a pressure, a sound wave, a particle flux, a weak nuclear force, a strong nuclear force, and a gravity force.



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#### **IX. EVIDENCE APPENDIX**

None

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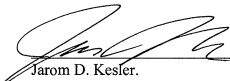
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**X. RELATED PROCEEDINGS APPENDIX**

None

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Jarom D. Kesler.  
Registration No. 57,046  
Attorney of Record  
Customer No. 20,995  
(949) 760-0404

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